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Compassion and envy in welfare comparisons

Flaviana Palmisano*

Abstract

Normative-based distributional comparisons across countries and over time usually build upon the assumption that individuals are selfish. However, there is a consolidated evidence that individuals also care about what others have. In this paper we propose a framework for comparing and ranking distributions that includes non-individualistic possibilities. Specifically, we consider ranking criteria that account, in one case, for the feeling of compassion that is generated by those having lower resources and, in the other case, for the feeling of envy that is generated by those having higher resources. We illustrate our framework using CNEF data for Australia, Korea, Germany, Russia, Switzerland and the US and show that accounting for the presence of envy and compassion might lead to different rankings.

Keywords: ranking criteria, compassion, envy, social welfare, CNEF. **JEL codes**: D63, I31, O12.

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1 Introduction

Since the pioneering works of Kolm (1969) and Atkinson (1970), the derivation of normative-based partial ranking criteria for distributional evaluations has become a prominent topic in welfare economics. Most of the contributions in this filed develop sets of dominance conditions to rank distributions of income according to given classes of social welfare functions and investigate on the implications of different assumptions on the form of the social welfare functions (see, among others, Atkinson and Bourguignon 1987, Lambert and Ramos 2002, Aaberge et al. 2013). Such criteria are widely adopted to evaluate the performances of societies. For instance, they have been used to study the normative and distributive effects on the population of periods or sustained growth or recession, as in the case of the 2007 financial crisis followed by the crisis of the sovereign debts in 2011. These models have also been implemented to evaluate the effects of the introduction of public policies and tax reforms (see, among others, Bourguignon 2011, Jenkins and Van Kerm 2016).

A common feature to these models is the 'self-regarding' property postulating that a society is composed by agents who only care about the amount of income that they can enjoy. However, there is consolidated evidence, based on experimental and survey data, that the magnitude of the income received by an individual constitutes only part of the relevant information for the assessment of her wellbeing (see Deaton 2003, Alpizar et al. 2005, Luttmer 2005, Ferrer-i-Carbonell 2005, Senik 2009, Quintana-Domeque and Wohlfart 2016, Clark et al. 2017). Individuals are not living in isolated islands, in most cases individuals' well-being is unavoidably related to the (complex) society in which they live and the way they evaluate their own achievements strictly depends on the achievements of others. Hence, individuals have other-regarding preferences, that is, they care about their own income and the income levels enjoyed by other individuals in the same society.

The literature has provided theoretical foundations for the presence of relative concerns and their impact on individuals' well being (see, among others, Cole et al 1992 and Fher and Schmidt 1998). The essential idea of relative concerns is that individual economic welfare depends (at least in part) on how the individual is doing relative to a set of comparators in society. Several models of other-regarding preferences have been proposed (see for a survey Dhami 2016). Some theories of relative concerns predict negative welfare effects when friends and neighbors become better-off. For instance models of 'pride' assume that any improvement for others, either richer or poorer, has a negative effect on own utility (Friedman, 2005). By contrast, other theories predict a negative welfare effect only when richer individuals get richer: these are the models of 'envy'; whereas, a welfare improvement experienced by more disadvantaged individuals has a positive effect on own utility: these are the models of 'compassion' (Bolton and Ockenfels 2000, Fehr and Schmidt 1998). It is on these two classes of models that we focus on in this paper.

Specifically, we address the issue of how different states of the world should be compared from the perspective of a social planner knowing that individuals are characterized by feelings of envy and compassion. The first step in our analysis consists in building a social welfare function expressing our ethical concerns. The concept of compassion can be formulated by looking at individuals that fall in the bottom part of the distribution - the disadvantaged part of the population toward which the richer feel compassionate - and by favoring progressive transfers that allow to improve their standard of living. In a specular way, the concept of envy will be formulated by looking at individuals that sit in the upper part of the distribution - the advantaged part of the population that represents a source of envy for the rest of the population. We will exploit these basic intuitions in the paper and we will translate it into formal axioms that will be imposed on the social evaluation functions. Analytically, we will characterize partial orderings defined over income distributions that will be coherent with social preferences endorsing aversion either to the feeling of envy or to the feeling of compassion. In our framework, the sources of compassion and envy would disappear with a perfectly equal distribution, hence the standard property of inequality aversion would correspond to a situation in which aversion to the feeling of compassion and aversion to the feeling of envy would offset each other.

Our work is related to that part of the literature that proposes indexes of relative deprivation and satisfaction and can be considered direct proxies of the extent of envy and compassion in a society (see, for instance, Chackravarty 1997, Magdalou and Moyes 2009, Esposito 2018). Now, while all this contributions develop different methodologies to assess either relative deprivation or satisfaction, we instead provide welfare ranking criteria that account for the aversion either toward the feeling of compassion or toward the feeling of envy in the society.

We adopt this theoretical framework to make pairwise welfare comparisons considering six different countries - namely Australia, Germany, Korea, Russia, Switzerland, and the U.S. - and to evaluate the evolution of each of these countries between 2001 and 2009. We find that Switzerland, followed by US and Australia, surfaces as the best-performing country, that is, its distribution turns out to be the dominating one in the largest number of pairwise comparisons. On the other hand, Russia, Korea, and Germany turn out to be the worst-performing, that is, their distribution turns out to be the dominated one in most of the pairwise comparisons considered. We also show that implementing evaluation criteria that include aversion toward the feeling of envy or compassion may lead to a different assessment of the distributions under analysis. Thus, the empirical analysis gives further support to the relevance of adopting our framework for distributional comparisons over time and across different populations.

The rest of the paper is structured as follows. Section 2 presents the theoretical framework and provides a set of four criteria that can be adopted for making distributional comparisons. Section 3 provides an empirical illustration. Section 4 concludes.

2 Ranking criteria

Let a distribution of individual incomes, y, be represented by its cumulative distribution function (cdf) denoted by F(y) and let F be the set of all such cumulative distributions. We are interested in judging F from a normative perspective. We assume that a social planner is endowed with cardinal preferences over such income distribution denoted by W(F). Let Z be the set of social preferences. For a social planner with preferences $W \in Z$, the choice of the most socially preferred distribution depends on the class of preferences Z. If the set of preferences Win society was known, we could directly check welfare dominance under the two different income distributions compared. In practice, this is not possible. Hence, we need to reformulate the dominance expressed in terms of W in a dominance expressed in terms of a restriction that involves only the observables, i.e. the income distributions under alternative states of the world. This can only be realized by imposing restrictions on the class Z of social preferences. To represent such preferences, we resort to the rank-dependent model proposed by Yaari (1987). It assumes that the welfare derived from a risky distribution can be written as a weighted average of all possible realizations, where the weights are a function of the rank of the realization in the distribution. Thus, let $w(p) \ge 0 \forall p \in [0, 1]$ be a differentiable function and denote the weight assigned to the individuals ranked p in the income distribution F, hence $p \in [0, 1]$, so that $F^{-1}(p) = \inf \{y : F(y) \ge p\}$. The social preference over such income distribution can be defined as follows:

$$W(F) = \int_{0}^{1} \omega(p) F^{-1}(p) dp$$
 (1)

The evaluation of a given society will be the result of a weighted aggregation across individuals, where the weighting scheme is constructed upon the relative position of individuals in the income distribution. Restrictions on weights will define different classes of social welfare functions, characterized by different normative implications. Hence concerns for compassion and envy, separately, will be expressed throughout such restrictions.

The first ranking criterion we propose is formalized in the following Proposition $1.^1$

Proposition 1. Given two income distributions F(y) and $G(y) \in F$ and a threshold percentile \bar{p} , $W(F) \geq W(G) \ \forall W \in Z$ such that $\omega'(p) \leq 0 \ \forall p \in [0, \bar{p}]$, $\omega'(p) = 0 \ \forall p \in [\bar{p}, 1]$ and $\omega(p) \geq \omega(s) \geq 0 \ \forall p \in [0, \bar{p}]$ and $s \in [\bar{p}, 1]$ if and only if

(i)
$$\Phi(p) \ge 0 \ \forall p \in [0, \bar{p}]$$

(ii) $\Xi(1) \ge 0$

where $\Phi(p) = \int_0^p F^{-1}(q) - G^{-1}(q) dq$ and $\Xi(1) = \int_{\bar{p}}^1 F^{-1}(s) - G^{-1}(s) ds$.

According to Proposition 1, in order to judge one distribution as superior to 1 All proofs are gathered in Appendix A.

another distribution two conditions need to be satisfied. The first is a second order inverse stochastic dominance condition that must hold for every percentile of the distribution up to \bar{p} . This dominance means that the cumulated income in the dominant distribution must be nowhere lower than the cumulated income in the dominated distribution up to the threshold level \bar{p} . The second condition requires checking that the average income in the upper part (specifically from \bar{p} to 1) of the dominant distribution is not lower than the average income in the upper part of the dominated distribution. This proposition is based on the ideal that the higher the income of the more disadvantaged part of the society the lower will be the feeling of compassion suffered by individuals the more socially desirable will be a distribution, by safeguarding at the same time efficiency in the higher part of the distribution (through condition (ii)). The distinction between the two parts of the distribution depends on the value of the threshold \bar{p} that we assume it is defined exogenously.² Special cases of Proposition 1 are obtained by selecting two particular values for the threshold \bar{p} . That is, for $\bar{p} = 1$ Proposition 1 boils down to a standard second order inverse stochastic dominance condition, reflecting a standard inequality aversion property in which aversion to the feeling of compassion and aversion to the feeling of envy would compensate each other. Whereas, for $\bar{p} = 0$ Proposition 1 boils down to a dominance test applied on the average income of the two distributions. This Proposition formalizes the ranking criterion that a social planner with particular preferences should adopt. These preferences encompass a common monotonicity (or efficiency) property represented by $\omega(p) > 0$ for all $p \in [0, 1]$, according to which an increase in individual income never reduces social welfare, independently on where the individual sits in the distribution, and a property that we define as aversion to the feeling of compassion and that is obtained by imposing $\omega'(p) \leq 0 \ \forall p \in [0,\bar{p}], \ \omega'(p) = 0 \ \forall p \in [\bar{p},1] \ \text{and} \ \omega(p) \geq \omega(s)$ $\forall p \in [0, \bar{p}] \text{ and } s \in [\bar{p}, 1].$ This property by focusing on the part of the distribution encompassed between 0 and \bar{p} introduces a concern for the disutility generated by the compassion felt by those individuals ranked above \bar{p} . Technically this property says that the marginal effect of a reduction of income on social welfare is higher the poorer is the individual and hence the higher the feeling of compassion that is generated among those richer than him. Whereas, the marginal effect of a reduc-

 $^{^{2}}$ It could correspond for instance to the median or to the bottom 20% of the distribution.

tion in income is constant for those that are not considered as disadvantaged and hence that do not represent a source of compassion. Hence a progressive transfer between individuals ranked above \bar{p} does not have any effect on social welfare, whereas a progressive transfer from an individuals ranked above \bar{p} to an individual ranked below as well as a progressive transfer between individuals both ranked below \bar{p} reduces the feeling of compassion and may increase social welfare.

Proposition 2. Given two income distributions F(y) and $G(y) \in F$ and a threshold percentile \bar{p} , $W(F) \geq W(G) \ \forall W \in Z$ such that $\omega'(p) \leq 0 \ \forall p \in [\bar{p}, 1]$, $\omega'(p) = 0 \ \forall p \in [0, \bar{p}]$ and $\omega(p) \geq \omega(s) \geq 0 \ \forall p \in [0, \bar{p}]$ and $s \in [\bar{p}, 1]$ if and only if

$$(i) \ \Xi(s) \ge 0 \ \forall s \in [\bar{p}, 1]$$

 $(ii) \ \Phi(\bar{p}) \ge 0$

where $\Xi(s) = \int_{\bar{p}}^{s} F^{-1}(t) - G^{-1}(t) dt$ and $\Phi(\bar{p}) = \int_{0}^{\bar{p}} F^{-1}(q) - G^{-1}(q) dq$.

Proposition 2 formalizes a ranking criterion that the social planner should apply in case of aversion to the feeling of envy generated by an income distribution. This criterion is composed by two conditions. As in Proposition 1, the first is a second order inverse stochastic dominance condition, but differently from Proposition 1 this condition must hold for every percentile of the distribution between \bar{p} and 1. The second condition imposes that the average income in the lower part of the distribution, specifically from 0 to \bar{p} cannot be lower in the dominant distribution distribution. The principle underlying this proposition is that the higher the income of the richest individuals the higher will be the feeling of envy in a society. $w(p) \ge 0 \forall p \in [0,1]$ ensures that an increase in income of one individual, ceteris paribus, does not decrease social welfare. At the same time, the envy aversion endorsed by the social planner is reflected in the structure of the weighting scheme: $\omega'(p) \leq 0 \ \forall p \in [\bar{p}, 1], \ \omega'(p) = 0 \ \forall p \in [0, \bar{p}] \ \text{and} \ \omega(p) \geq \omega(s) \ \forall p \in [0, \bar{p}] \ \text{and}$ $s \in [\bar{p}, 1]$. Such weights, by focusing on the part of the distribution encompassed between \bar{p} and 1 introduce a concern for the feeling of envy that is felt by those individuals ranked below \bar{p} . According to these conditions, the marginal effect of an increase of income on social welfare is lower the richer is the individual and

hence the lower the feeling of envy that is generated among those poorer than him. Whereas, the marginal effect of a reduction in income is constant for those that are not considered as advantaged and hence that do not represent a source of envy, but it safeguards efficiency in the lower part of the distribution (through condition (ii)). Hence a progressive transfer between individuals ranked below \bar{p} does not have any effect on social welfare, whereas a progressive transfer from an individuals ranked above \bar{p} to an individual ranked below as well as a progressive transfer between individuals both ranked above \bar{p} reduces the feeling of envy and may increase social welfare. Clearly, for $\bar{p} = 1$ and $\bar{p} = 0$, Proposition 1 and 2 will coincide.

In case of intersection in condition (i) of either Proposition 1 or 2, or if condition (i) and (ii) of either Proposition 1 or 2 result in a conflicting dominance, the two distributions cannot be ranked. Hence, we need to identify the minimal refinement on the set of admissible preferences that allows unambiguous assessments of distributions. This is done in the following two propositions. In particular, one can resort to the test proposed in Proposition 3 if Proposition 1 results in a clash of the distributions compared. Similarly, the test proposed in Proposition 4 can be implemented if it is Proposition 2 that generates incomplete rankings.

Proposition 3. Given two income distributions F(y) and $G(y) \in F$ and a threshold percentile $\bar{p}, W(F) \geq W(G) \ \forall W \in Z$ such that $\omega'(p) \leq 0$ and $\omega''(p) \geq 0$ $\forall p \in [0, \bar{p}]$ and $\omega'(p) = 0 \ \forall p \in [\bar{p}, 1]$ and $\omega(p) \geq \omega(s) \geq 0 \ \forall p \in [0, \bar{p}]$ and $s \in [\bar{p}, 1]$ if and only if

 $(i) \Psi(p) \ge 0 \forall p \in [0, \bar{p}]$ $(ii) \Phi(\bar{p}) \ge 0; \Phi(\bar{p}) + \Xi(1) \ge 0$

where $\Psi(p) = \int_0^p \Phi(q) dq$.

Proposition 3 characterizes a ranking criterion based on two conditions. Condition (i) is a (upward) third order inverse stochastic dominance condition up to \bar{p} . Condition (ii) is a sequential test composed of two steps. The first step consists in checking the dominance between the average income of the bottom part of the distribution up to \bar{p} , it coincides with the last step of condition (i) in Proposition 1. In the second step, the average income of the upper part of the distribution is added. Differently from Proposition 1, we are restricting the set of preferences for which the dominance must hold to those satisfying $\omega''(p) \ge 0 \forall p \in [0, \bar{p}]$ asking that one should prefer progressive transfers taking place at the very bottom part of the distribution to progressive transfer taking place somewhere above. If the transfer takes place from the one individual ranked above \bar{p} to one individual ranked below \bar{p} , then one should prefer transfers that benefit individuals that are the poorest among those ranked below \bar{p} . Both kinds of transfers that one should prefer are those that focus on individuals whose economic conditions generates the highest feeling of compassion.

Proposition 4. Given two income distributions F(Y) and $G(Y) \in F$ and a threshold percentile \bar{p} , $W(F) \geq W(G) \ \forall W \in Z$ such that $\omega'(p) \leq 0$, $\omega''(p) \leq 0$ $\forall p \in [\bar{p}, 1]$, $\omega'(p) = 0 \ \forall p \in [0, \bar{p}]$ and $\omega(p) \geq \omega(s) \geq 0 \ \forall p \in [0, \bar{p}]$ and $s \in [\bar{p}, 1]$ if and only if

(i) $\Omega(s) \ge 0 \ \forall s \in [\bar{p}, 1]$ (ii) $\Phi(\bar{p}) \ge 0; \Phi(\bar{p}) + \Xi(1) \ge 0.$

where $\Omega(s) = \int_{s}^{1} \Xi(t) dt$.

Proposition 4 characterizes a ranking criterion based on (i) downward third order inverse stochastic dominance condition between \bar{p} and 1 and (ii) on a sequential dominance test applied to the average income of the different parts of the distribution as for condition (ii) of Proposition 3. Differently from Proposition 2, we are restricting the set of preferences for which the dominance must hold to those satisfying $\omega''(p) \leq 0 \forall p \in [\bar{p}, 1]$, asking that among all possible progressive transfers that could be implemented in the group of advantaged individuals, one should prefer progressive transfers taking place between individuals ranked very close to 1 to progressive transfers taking place between individuals ranked very close to \bar{p} . Such kinds of transfers are those that focus on individuals whose economic conditions generates the highest feeling of envy. Differently from Proposition 3, if the transfer takes place from one individual ranked above \bar{p} to one individual ranked below \bar{p} , then one is indifferent with respect to a transfers that benefit the poorest among those ranked below \bar{p} or that benefits individuals less poor among those ranked below \bar{p} .

From a technical point of view, it is interesting to notice that while condition (i) of all previous propositions is based on a upward dominance test, condition (i) of Proposition 4 introduces a dominance test to be implemented through a 'downward' procedure, which means that one has to start from the highest percentile, add sequentially the income corresponding to lower percentiles, and check that the dominance holds at every step of the downward cumulative process.³

3 Empirical illustration

3.1 Data

Our empirical illustration is based on the Cross National Equivalent File (CNEF), designed at Cornell University to provide harmonized data for a set of countryspecific representative surveys of their resident population. In particular we consider Australia (CNEF version of the Household Income and Labour Dynamics in Australia - HILDA), Germany (CNEF version of the German Socio-Economic Panel - SOEP), Korea (CNEF version of the Korea Labor and Income Panel Study - KLIPS), Russia (CNEF version of the Russian Longitudinal Monitoring Survey of HSE - RLMS-HSE), Switzerland (CNEF version of the Swiss Household Panel - SHP), and the US (CNEF version of the US panel Study of Income Dynamics -PSID).⁴ We use the 2001 and 2009 waves and we make cross-country comparisons in each of the two waves, then for each country me perform a temporal comparison. The unit of observation is the individual. The measure of living standards is equivalized disposable household income, which includes income after transfers and the deduction of income tax and social security contributions. Incomes are expressed in constant 2005 prices, using country and year-specific price indexes and are adjusted for differences in household size by dividing incomes by the square

³See on this Aaberge et al. 2013.

⁴PanelWhiz could also be used to access such datasets, see Hahn and Haisken-DeNew (2010).

root of the household size. They are then expressed in 2005 Purchasing Power Parity. Individuals with zero sampling weights are excluded since our measures are calculated using sample weights designed to make the samples nationally representative.

Some descriptive statistics are reported in Table 4 in Appendix B. We can see that the countries in our sample differ in terms of mean incomes and Gini coefficient. In both waves considered, mean income is highest in US and Switzerland, the country that also has the lowest Gini index after Germany.

3.2 Results

We now apply the dominance tests presented in Section 2 to rank countries and check whether the ranking obtained is stable over time. Then we turn to evaluate the country-specific performance over time. The results are obtained through pairwise comparisons of the countries analyzed. To implement our framework, however, we need to select the threshold \bar{p} that we fix at the median.⁵

We start from Proposition 1, where efficiency and compassion matter. Table 1 shows that although the conditions imposed in this proposition are quite strong it requires second-order dominance of the income of each percentile up to p = 0.50(Figure 1) and dominance of average income of the upper part of the distribution (Table 2) - some of distributions can already be ranked. In particular, for 2001 we find that Russia is dominated by all the other countries and there is no county that dominates all the others. We also find that Switzerland dominates all the other countries with the exception of Germany and US, as well as, US dominates all the other countries with the exception of Switzerland and Germany.

The impossibility to establish a ranking for the other pairwise comparisons depends, from one side, on the fact that condition (i) is not satisfied for all pairwise comparisons made as there appear to be some crossings between the curves reported in Figure 1 (this is the case of Germany and Switzerland, of Germany and US, and of Switzerland and US). From the other side, when the curves do not cross the impossibility to establish the sign of the dominance derives from observing that condition (ii) generates an opposite ranking with respect to condition

⁵In Appendix D we replicate the analysis by setting \bar{p} equal to the 0.25.

	Germany	Korea	Russia	Switzerland	US
	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)
			Proposition 1		
Australia	ø (ø)	> (>)	> (>)	< (<)	< (<)
Germany		ø (ø)	> (>)	ø (<)	ø (ø)
Korea			ø (ø)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 2		
Australia	ø (>)	> (>)	> (>)	< (ø)	< (ø)
Germany		ø (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 3		
Australia	ø (ø)	> (>)	> (>)	< (<)	< (<)
Germany		ø (ø)	> (>)	ø (<)	ø (ø)
Korea			ø (ø)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 4		
Australia	> (>)	> (>)	> (>)	< (ø)	< (ø)
Germany		ø (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)

Table 1: Test of Proposition 1, 2, 3 and 4, cross-country comparison in 2001 and 2009 $\,$

Source: Author's Elaboration based on CNEF. Note: \emptyset denotes a non conclusive test; > (<) indicates that the first distribution dominates (is dominated by) the second distribution.

(i) (this is the case of Australia and Germany, Germany and Korea, Switzerland and US). After eight years, the ranking is stable and there are only two changes. One change concerns Switzerland and Germany that can now be ranked (with the former country dominating the latter). The second change concerns Korea and Russia that can no longer be compared.



Figure 1: Test of Proposition 1 condition (i), cross-country comparison in 2001 and 2009

Source: Author's Elaboration based on CNEF.

	Proposition 1	Proposition 1	Proposition 2	Proposition 2
	Condition ii	Condition ii	Condition ii	Condition ii
	2001	2009	2001	2009
Australia	34,936	43,464	13,068	17,150
Germany	31,686	33,242	14,400	14,010
Korea	33,080	42,074	6,868	10,869
Russia	6,819	12,681	1,887	4,272
Switzerland	42,640	43,666	18,600	20,131
US	54,969	57,821	17,783	16,881

Table 2: Test of Proposition 1 and 2, condition (ii), cross-country comparison in 2001 and 2009

Source: Author's Elaboration based on CNEF.

We now consider the test proposed in Proposition 2, promoting efficiency and expressing concerns with respect to the feeling of envy. The summary results are reported in Table 1 and show that the ranking of countries might change when the social planner is concerned with envy rather then compassion. This is the case, in our empirical illustration, of the comparison between Australia and Germany in 2009 that can be ranked when one considers aversion to envy (with the former country dominating the latter) but cannot be ranked when one considers aversion to compassion. While a similar conclusion holds for Korea and Russia and for US and Germany, the opposite happens for the comparison between Australia and Switzerland and between Australia and US in 2009: Australia is always dominated when one accounts for aversion to the feeling of compassion; this is not true when one accounts for aversion to the feeling of envy.

In 2001, the only two rankings that change when moving from compassion aversion to envy aversion are those between Switzerland and Germany and Germany and US. As shown in Figure 2 reporting the result of condition (i) of Porposition 2, the curve related to Germany always lies below that of Switzerland and US; condition (ii) whose results are reported in Table 2 confirms the dominance.



Figure 2: Test of Proposition 2 condition (i), cross-country comparison in 2001 and 2009

Source: Author's Elaboration based on CNEF.

When the application of the tests proposed in the first two Propositions cannot help to establish a clear dominance between countries, one can resort to the test proposed respectively in Proposition 3 when Proposition 1 fails and in Proposition 4 when Proposition 2 fails. While Propositions 3 confirms the rankings established with Proposition 1, Proposition 4 helps in solving one instance of ambiguous ranking. It is the case of the comparison between Australia and Germany in 2001, while the two countries could not be ranked according to Proposition 2, Australia dominates Germany according to Proposition 4 (see Table 1).⁶

If we consider the number of pairwise comparisons in which a given country turns out to be the dominant country, we observe that Switzerland is at the top of the ranking: it turns out to be the dominant country 28 times out of 40 pairwise comparisons (20 in 2001 and 20 in 2009) and it is never dominated. It is followed by US, which turns out to be the dominant country 26 times and it is never dominated. Russia ranks at the bottom: it is dominated 38 times. It is followed by Korea, dominated 24 times. Australia and Germany lies in between: Australia that is the dominant country in 19 instances of comparison and it is dominated 12 times; Germany that is dominated 13 times and it is the dominant country in 8 instances of comparison.

In order to better grasp the relevance of adopting the framework proposed when making distributional comparisons, we report the results of the dominance test that would be implemented if the preferences of a social planner would be represented by the standard property of inequality aversion. This is done in Figure 3 reporting a standard second order inverse stochastic dominance. Formally we implement the following test: $\int_0^p F^{-1}(q) dq \ge \int_0^p G^{-1}(q) dq \forall p \in [0, 1].$



Figure 3: Standard dominance test: cross-country comparison in 2001 and 2009

Source: Author's Elaboration based on CNEF.

These results show that accounting either for compassion or for envy might

 $^{^{6}\}mathrm{Details}$ on condition (i) and (ii) of Proposition 3 and 4 are reported in Appendix C.

generate different conclusions concerning each pairwise distributional comparison performed. When we account for compassion there is only one pairwise comparisons that generates a different result (this is the case of Germany vs Korea in 2001, with Germany dominating Korea according to the standard procedure and no dominance found with our procedure). When we account for envy, there are more instances of non-coincident results (this is the case of Germany vs Switzerland and US in 2001 and Australia vs Germany and Switzerland, Germany vs Us and Korea vs Russia in 2009).

The framework proposed in this paper can be implemented to evaluate the social welfare improvement experienced by each country over time, thereby comparing the same country in different periods through the tests proposed in Proposition 1 to 4. This is done in Table 3, reporting for each country the result of the comparison between 2001 and 2009. Again, the tests proposed allowed for an unambiguous ranking in almost all the pairwise comparisons proposed. It is interesting to notice that while for the majority of countries the 2009 ranks above the 2001 hence witnessing a welfare improvement, this is not the case for Germany and US country for which the 2001 dominates the 2009, thus witnessing a worsening of social welfare over time.

	2001 vs 2009					
	Proposition 1	Proposition 2	Proposition 3	Proposition 4		
Australia	<	<	<	<		
Germany	ø	>	ø	>		
Korea	<	<	<	<		
Russia	<	<	<	<		
Switzerland	<	<	<	<		
US	ø	ø	ø	>		

Table 3: Test of Proposition 1, 2, 3, and 4 for each country: 2001 vs 2009

Source: Author's Elaboration based on CNEF. Note: \emptyset denotes a non conclusive test; > (<) indicates that the first distribution dominates (is dominated by) the second distribution.

We conclude our analysis with two robustness checks. The first concerns the choice of the threshold p that is fixed at 0.25 in Appendix D; the second concerns the choice of the samples considered that are restricted to the working age pop-

ulation in Appendix E. As Table 6 and 7 show, our overall conclusions are not affected by these choices.

4 Conclusions

A large number of contributions propose alternative models to evaluate and compare distributions of income from a normative perspective, most of them build upon the assumption that the society is made of individuals with self-regarding preferences. At the same time, behavioral economists have shown, through empirical and experimental analyses, that individuals do have social preferences and their well-being depends non only on their own specific level of income but also on the level of income perceived by those that are richer or poorer. In this paper, we have argued that a social planner that is willing to account for the feelings of compassion - that is generated by those having access to relatively lower income and envy - that is generated by those having access to relatively higher income - in the evaluation of alternative states of the world, should adopt criteria that differ from those that have already been proposed by the literature.

Hence, we have used the rank dependent model proposed by Yaari (1907) and we have imposed restrictions on the weights that incorporate either aversion to the feeling of compassion or aversion to the feeling of envy. Such restrictions allowed us to obtain new dominance criteria that can be used to rank countries for a given period according to social welfare or for a given country to make comparisons across time.

We have used this framework to perform pairwise comparisons for six countries: Australia, Germany, Korea, Russia, Switzerland, and the U.S. Our results show that Switzerland proves to be the best-performing country followed by US and Australia. While Germany, Korea and Russia ranks among the less desirable.

The results derived in our paper can be extended in a number of directions. For instance, it would be interesting to investigate how the existing criteria for the evaluation of distributional changes would be modified to account for compassion and envy. The framework proposed could also be extended to endorse an intertemporal perspective. These extensions will be the subject of future research.

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Appendix A

Proofs

Proof of Proposition 1

We want to find sufficient and necessary conditions for

$$\Delta W = \int_0^1 \omega(p) \left(F^{-1}(p) dp_t - G^{-1}(p) dp \right) \ge 0$$
 (2)

Letting $\Delta(p)dp = F^{-1}(p) - G^{-1}(p)$, rewrite Equation 2 as follows:

$$\Delta W = \int_0^1 \omega(p) \Delta(p) dp \ge 0 \tag{3}$$

For a given \bar{p} , rewrite Equation 3 as follows:

$$\Delta W = \int_0^{\bar{p}} \omega(p) \Delta(p) dp \ge 0 + \int_{\bar{p}}^1 \omega(s) \Delta(s) ds \ge 0 \tag{4}$$

For the sufficiency part, we integrate by parts Equation 4:

$$\omega(\bar{p}) \int_{0}^{\bar{p}} \Delta(p) dp - \int_{0}^{\bar{p}} \omega'(p) \int_{0}^{p} \Delta(q) dq dp +$$

$$\omega(1) \int_{\bar{p}}^{1} \Delta(s) ds - \int_{\bar{p}}^{1} \omega'(s) \int_{0}^{s} \Delta(t) dt ds$$
(5)

For $\omega'(s) = 0 \forall s \in [\bar{p}; 1]$ and using the following notation $\Phi(p) = \int_0^p \Delta(q) dq$, $\Phi(\bar{p}) = \int_0^{\bar{p}} \Delta(p) dp$ and $\Xi(1) = \int_{\bar{p}}^1 \Delta(s) ds$, the above equation becomes:

$$\omega(\bar{p})\Phi(\bar{p}) - \int_0^{\bar{p}} \omega'(p)\Phi(p)dp + \omega(1)\Xi(1)$$
(6)

Since $\omega'(p) \leq 0 \forall p \in [0, \bar{p}], \Phi(p) \geq 0$ for all $p \in [0, \bar{p}]$ implies $-\int_0^{\bar{p}} \omega'(p) \Phi(p) dp \geq 0$, and since $\omega(\bar{p}) \geq 0$, it also implies that $\omega(\bar{p}) \Phi(\bar{p}) \geq 0$. Hence, given $\omega(1) \geq 0$, $\Phi(p) \geq 0$ for all $p \in [0, \bar{p}]$ and $\Xi(1) \geq 0$ are sufficient for $\Delta W \geq 0$.

For the necessity part, let $\Delta W \ge 0$, but assume that $\Phi(p) < 0$ for some $p \in [\alpha, \beta] \subset [0, \overline{p}]$ and that $\Xi(1) < 0$. Denoting $-\omega'(p) = \gamma(p)$, rewrite Equation 6

as follows:

$$\omega(\bar{p})\Phi(\bar{p}) + \int_0^{\bar{p}} \gamma(p)\Phi(p)dp + \omega(1)\Xi(1)$$
(7)

Hence, $\int_0^{\bar{p}} \gamma(p) \Phi(p) \leq 0$ for all $\gamma(p) \in V^+$ and $p \in [\alpha, \beta]$. Recalling that $\omega(1) \geq 0$ and assuming that $\Phi(p) \searrow 0$ for all $p \notin [\alpha, \beta]$, then the three terms of the above equation become negative resulting in $\Delta W < 0$, a contradiction.

Proof of Proposition 2

We want to find sufficient and necessary conditions for

$$\Delta W = \int_0^1 \omega(p) \Delta(p) dp \ge 0 \tag{8}$$

For the sufficiency part, consider equation (5). For $\omega'(p) = 0 \forall p \in [0; \bar{p}]$, denoting $\Xi(s) = \int_{\bar{p}}^{s} \Delta(t) dt$, $\Phi(\bar{p}) = \int_{0}^{\bar{p}} \Delta(p) dp$, and $\Xi(1) = \int_{\bar{p}}^{1} \Delta(s) ds$, the equation can be rewritten as:

$$\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) - \int_{\bar{p}}^{1} \omega'(s)\Xi(s)ds$$
(9)

Since $\omega'(s) \leq 0 \forall p \in [\bar{p}; 1], \Xi(s) \geq 0$ for all $s \in [\bar{p}; 1]$ implies $-\int_{\bar{p}}^{1} \omega'(s)\Xi(s)ds \geq 0$, and since $\omega(1) \geq 0$, it also implies that $\omega(1)\Xi(1) \geq 0$. Hence, given $\omega(\bar{p}) \geq 0$, $\Xi(s) \geq 0$ for all $s \in [\bar{p}; 1]$ and $\Phi(\bar{p})$ are sufficient for $\Delta W \geq 0$.

For the necessity part, let $\Delta W \geq 0$, but assume that $\Xi(s) < 0$ for some $s \in [\kappa, \lambda] \subset [\bar{p}; 1]$ and that $\Phi(\bar{p}) < 0$. Denoting $-\omega'(s) = \theta(s)$, rewrite Equation 9 as follows:

$$\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) + \int_{\bar{p}}^{1} \theta(s)\Xi(s)ds$$
(10)

Hence, $\int_{\bar{p}}^{1} \theta(s) \Xi(s) \leq 0 ds$ for all $\theta(s) \in V^{+}$ and $s \in [\kappa, \lambda]$. Recalling that $\omega(\bar{p}) \geq 0$ and assuming that $\Xi(s) \searrow 0$ for all $p \notin [\kappa, \lambda]$, then the three components of the previous equation become negative, which results in $\Delta W < 0$, a contradiction.

Proof of Proposition 3

We want to find sufficient and necessary conditions for

$$\Delta W = \int_0^1 \omega(p) \Delta(p) dp \ge 0 \tag{11}$$

For the sufficiency proof, consider Equation 6, using the following notation $\Psi(p) = \int_0^p \Phi(q) dq$, $\Psi(\bar{p}) = \int_0^{\bar{p}} \Phi(q) dq$ and integrating by parts the second component:

$$\omega(\bar{p})\Phi(\bar{p}) - \omega'(\bar{p})\Psi(\bar{p}) + \int_0^{\bar{p}} \omega''(p)\Psi(p)dp + \omega(1)\Xi(1)$$
(12)

Since $\omega''(p) \ge 0 \forall p \in [0, \bar{p}], \Psi(p) \ge 0$ for all $p \in [0, \bar{p}]$ implies $\int_0^{\bar{p}} \omega''(p)\Psi(p) \ge 0$, and since $\omega(\bar{p})' \le 0$, it also implies that $-\omega(\bar{p})'\Psi(\bar{p}) \ge 0$. Hence, given $\omega(\bar{p}) \ge \omega(1) \ge 0$ we can apply Abel lemma so that $\Psi(p) \ge 0$ for all $p \in [0, 1], \Phi(\bar{p}) \ge 0$ and $\Phi(\bar{p}) + \Xi(1) \ge 0$ are sufficient for $\Delta W \ge 0$.

For the necessity part, let $\Delta W \geq 0$, but assume that $\Psi(p) < 0$ for some $p \in [\alpha, \beta] \subset [0, \bar{p}]$ and that $\Phi(\bar{p})$ and $\Phi(\bar{p}) + \Xi(1) < 0$ and recall equation 12, $\int_0^{\bar{p}} \omega(p)'' \Psi(p) \leq 0$ for all $\omega(p)'' \in V^+$ and $p \in [\alpha, \beta]$. Assuming that $\Psi(p) \searrow 0$ for all $p \notin [\alpha, \beta]$, then $-\omega'(\bar{p})\Psi(\bar{p}) + \int_0^{\bar{p}} \omega''(p)\Psi(p) \leq 0$. Recalling that $\omega(\bar{p}) \geq \omega(1) \geq 0$, by Abel Lemma $\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) \leq 0$, which would result in $\Delta W < 0$, a contradiction.

Proof of Proposition 4

We want to find sufficient and necessary conditions for

$$\Delta W = \int_0^1 \omega(p) \Delta(p) dp \ge 0 \tag{13}$$

For the sufficiency proof, consider Equation 9, denote $\Theta(s) = \int_{\bar{p}}^{s} \Xi(t) dt$ and $\Theta(1) = \int_{\bar{p}}^{1} \Xi(t) dt$ integrate by parts the third component:

$$\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) - \omega'(1)\Theta(1) + \int_{\bar{p}}^{1} \omega''(s)\Theta(s)ds$$
(14)

The last component of the above equation can be rewritten as follows:

$$\int_{\bar{p}}^{1} \omega''(s) \left[\int_{\bar{p}}^{1} \Xi(t) - \int_{s}^{1} \Xi(t) \right] dt ds = \int_{\bar{p}}^{1} \omega''(s) \int_{\bar{p}}^{1} \Xi(t) dt ds - \int_{\bar{p}}^{1} \omega''(s) \int_{s}^{1} \Xi(t) dt ds.$$

Noting that $\int_{\bar{p}}^{1} \omega'' = \omega'(1) - \omega'(\bar{p})$, for $\omega'(1) = 0$ we have

$$-\omega'(\bar{p})\int_{\bar{p}}^{1}\Xi(s) - \int_{\bar{p}}^{1}\omega''(s)\int_{s}^{1}\Xi(t)dsdt$$

Denoting $\Omega(s) = \int_s^1 \Xi(t) dt$, ΔW can now be rewritten as follows:

$$\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) - \omega'(\bar{p})\Theta(1) - \int_{\bar{p}}^{1} \omega''(s)\Omega(s)ds.$$
(15)

Since $\omega''(s) \leq 0 \forall s \in [\bar{p}, 1], \Omega(s) \geq 0$ for all $s \in [\bar{p}, 1]$ implies $-\int_{\bar{p}}^{1} \omega''(s)\Omega(s)ds \geq 0$, and since $\omega(\bar{p})' \leq 0$, it also implies that $-\omega(\bar{p})'\Theta(1) \geq 0$. Hence, given $\omega(\bar{p}) \geq \omega(1) \geq 0, \ \Omega(s) \geq 0$ for all $s \in [\bar{p}, 1], \ \Phi(\bar{p}) \geq 0$ and $\Phi(\bar{p}) + \Xi(1) \geq 0$ are sufficient for $\Delta W \geq 0$.

For the necessity part, let $\Delta W \geq 0$, but assume that $\Omega(s) < 0$ for some $s \in [\kappa, \lambda] \subset [\bar{p}, 1]$ and that $\Phi(\bar{p})$ and $\Phi(\bar{p}) + \Xi(1) < 0$ and recall equation 15, $-\int_0^{\bar{p}} \omega(s)'' \Omega(s) \leq 0$ for all $\omega(p)'' \in V^-$ and $p \in [\kappa, \lambda]$. Assuming that $\Omega(s) \searrow 0$ for all $s \notin [\kappa, \lambda]$, then $-\omega'(\bar{p})\Theta(1) + \int_0^{\bar{p}} \omega''(s)\Omega(s) \leq 0$. Recalling that $\omega(\bar{p}) \geq \omega(1) \geq 0$, by Abel Lemma $\omega(\bar{p})\Phi(\bar{p}) + \omega(1)\Xi(1) \leq 0$, which would result in $\Delta W < 0$, a contradiction.

Appendix B

Descriptive Statistics

Table 4: Descriptive statistics by country and year

	Sample size	Sample size	Mean income	Mean income	Gini index	Gini index
	2001	2009	2001	2009	2001	2009
Australia	10.920	17 407	23,866	30,938	0.3136	0.3053
Australia	19,039	17,497	[23,639; 24,093]	[30,587; 31,289]	[0.3096; 0.3176]	[0.3002; 0.3103]
Germany	26 504	20,980	23,412	23,950	0.2610	0.2874
Germany	20,304		[23,201; 23,622]	[23,639; 24,260]	[0.2564; 0.2655]	[0.2805; 0.2941]
Karaa	11 104	11 710	16,445	25,814	0.3793	0.3914
Korea	11,194	11,710	[16,088; 16,802]	[25,278; 26,350]	[0.3678; 0.3908]	[0.3819; 0.4009]
Russia	0 7 7 7	0.054	4,521	8,797	0.4285	0.3520
Russia	0,727	9,054	[4,414; 4,628]	[8,581; 9,014]	[0.4186; 0.4384]	[0.338; 0.3658]
Curitmoniand	6 502	7 0 2 0	31,161	33,043	0.2942	0.2580
Switzerland 6,593	7,039	[30,523; 31,800]	[32,487; 33,599]	[0.2826; 0.3057]	[0.2491; 0.2669]	
110	11 761	16 972	34,804	35,107	0.3962	0.4161
05 1	11,761	10,873	[34,030; 35,578]	[34,214; 36,000]	[0.3861; 0.4064]	[0.4038; 0.4284]

Source: Author's Elaboration based on CNEF.

Appendix C

Test of Proposition 3 and 4, condition (i) and (ii)

Figure 4: Test of Proposition 3 condition (i), cross-country comparison in 2001 and 2009



Source: Author's Elaboration based on CNEF.

Figure 5: Test of Proposition 4 condition (i), cross-country comparison in 2001 and 2009



Source: Author's Elaboration based on CNEF.

	Propositio	on 3 and 4	Proposition 3 and 4		
	Condition ii – step 1		Condition ii – step 2		
	2001 2009		2001	2009	
Australia	13,068	17,150	24,002	30,307	
Germany	14,400	14,010	23,043	23,626	
Korea	6,868	10,869	19,974	26,471	
Russia	1,887	4,272	4,353	8,476	
Switzerland	18,600	20,131	30,620	31,898	
US	17,783	16,881	36,376	37,351	

Table 5: Test of Proposition 3 and 4, condition (ii), cross-country comparison in 2001 and 2009

Source: Author's Elaboration based on CNEF.

Appendix D

Setting $\bar{p} = 0.25$

Table 6: Test of Proposition 1, 2, 3 and 4, cross-country comparison in 2001 and 2009

	Germany	Korea	Russia	Switzerland	US
	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)
			Proposition 1		
Australia	ø (ø)	> (>)	> (>)	< (<)	< (<)
Germany		> (ø)	> (>)	ø (<)	ø (ø)
Korea			> (ø)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland		0			ø (ø)
			Proposition 2		
Australia	ø (>)	> (>)	> (>)	< (<)	< (ø)
Germany		> (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 3		
Australia	< (ø)	> (>)	> (>)	< (<)	< (<)
Germany		> (ø)	> (>)	ø (<)	ø (ø)
Korea			> (ø)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 4		
Australia	ø (>)	> (>)	> (>)	< (<)	< (ø)
Germany		> (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)

Source: Author's Elaboration based on CNEF. Note: ϕ denotes a non conclusive test; > (<) indicates that the first distribution dominates (is dominated by) the second distribution.

Appendix E

Working age population

Table 7: Test of Proposition 1, 2, 3 and 4, cross-country comparison in 2001 and 2009

	Germany	Korea	Russia	Switzerland	US
	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)	2001 (2009)
			Proposition 1		
Australia	ø (ø)	> (ø)	> (>)	< (<)	< (ø)
Germany		ø (ø)	> (>)	ø (<)	ø (ø)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					ø (ø)
			Proposition 2		
Australia	ø (>)	> (>)	> (>)	< (ø)	< (>)
Germany		ø (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					< (ø)
			Proposition 3		
Australia	ø (ø)	> (ø)	> (>)	< (<)	< (ø)
Germany		ø (ø)	> (>)	ø (<)	ø (ø)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland		8		S	ø (ø)
			Proposition 4		
Australia	ø (>)	> (>)	> (>)	< (<)	< (>)
Germany		> (ø)	> (>)	< (<)	< (<)
Korea			> (>)	< (<)	< (<)
Russia				< (<)	< (<)
Switzerland					< (ø)

Source: Author's Elaboration based on CNEF. Note: ϕ denotes a non conclusive test; > (<) indicates that the first distribution dominates (is dominated by) the second distribution.